Supporting Information:

Comparison between the Quantum Yields of Compact and Porous WO_3 Photoanodes

Karla R. Reyes-Gil[†], Craig Wiggenhorn, Bruce S. Brunschwig, and Nathan S. Lewis*

Beckman Institute and Kavli Nanoscience Institute
210 Noyes Laboratory, 127-72
California Institute of Technology
1200 E. California Blvd., Pasadena, CA 91125

* To whom correspondence should be addressed. Email: nslewis@caltech.edu

† Present address: Sandia National Laboratory, 7011 East Ave., Livermore, CA 94551

Table S1: Absorption coefficient vs. wavelength for WO_3, as estimated from references 44 and 45. These values were used for calculation of the minority-carrier diffusion lengths (**Error! Reference source not found.**11).

Wavelength (nm)	Abs. Coefficient (cm^{-1})	Abs. Length (μm)
250	6.18×10^5	0.016
260	5.48×10^5	0.018
270	4.86×10^5	0.021
280	4.31×10^5	0.023
290	3.39×10^5	0.030
300	2.51×10^5	0.040
310	1.65×10^5	0.061
320	1.15×10^5	0.087
330	6.31×10^4	0.159
340	4.14×10^4	0.24
350	2.56×10^4	0.39
360	1.59×10^4	0.63
370	9.80×10^3	1.02
380	6.06×10^3	1.7
390	3.98×10^3	2.5
400	2.46×10^3	4.1
410	1.06×10^3	9.4
420	5.17×10^2	19.3
430	2.51×10^2	40.
440	7.12×10^1	140.
450	9.23	1.08×10^3
460	1.52	6.58×10^3

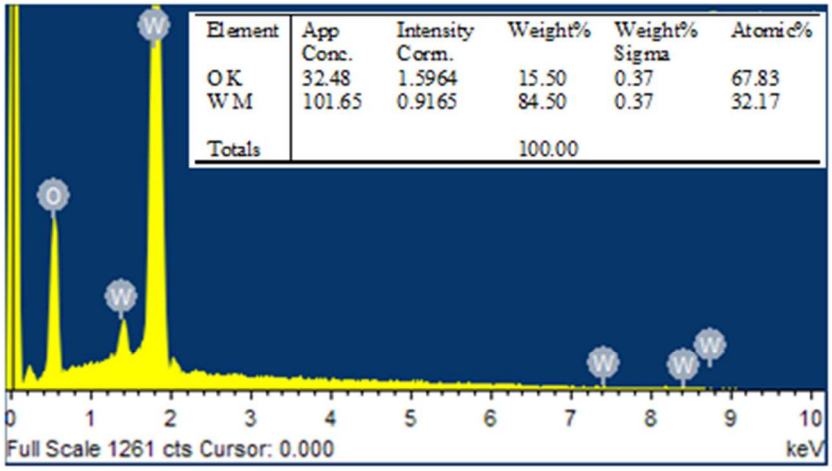

Figure S1: Energy dispersive X-ray (EDS) spectrum for porous WO_3 films. All of the peaks of the EDS spectrum were analyzed for elements with atomic numbers ≥ 4, the number of iterations was 3, and SiO_2 and W were used as standards for O and W, respectively.

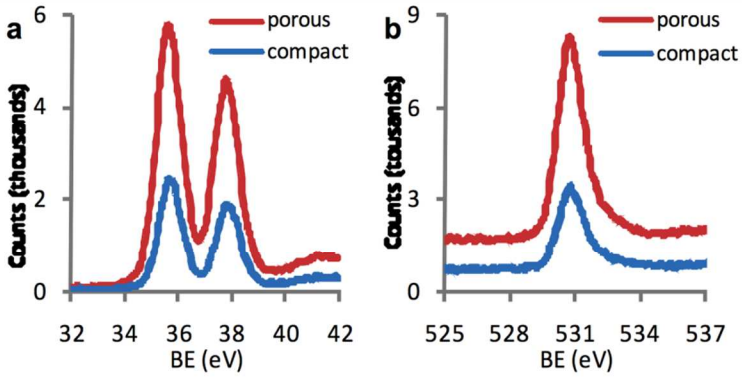

Figure S2: High-resolution X-ray photoelectron spectra (XPS) for porous and compact films of WO_3 (a) W $4f_{7/2}$ and W $4f_{5/2}$ and (b) O 1s spectral regions. The binding-energy scale was calibrated relative to the adventitious C 1s signal, taken to be at 284.6 eV.

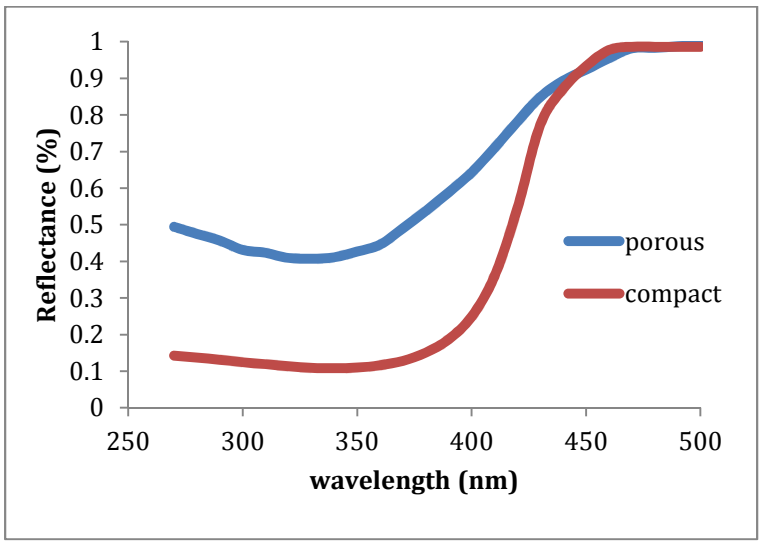

Figure S3: Diffuse reflectance spectra of compact and porous WO_3 films. W foil was used as reference. The porous WO_3 film used was prepared by anodization at 60 V for 9 h in 0.10 M NaF(aq). The reflectance, R, is defined as $R = I_F / I^0$, where I_F is the scattered light of the WO_3 film measured by an integrating sphere and I^0 is the reference intensity.

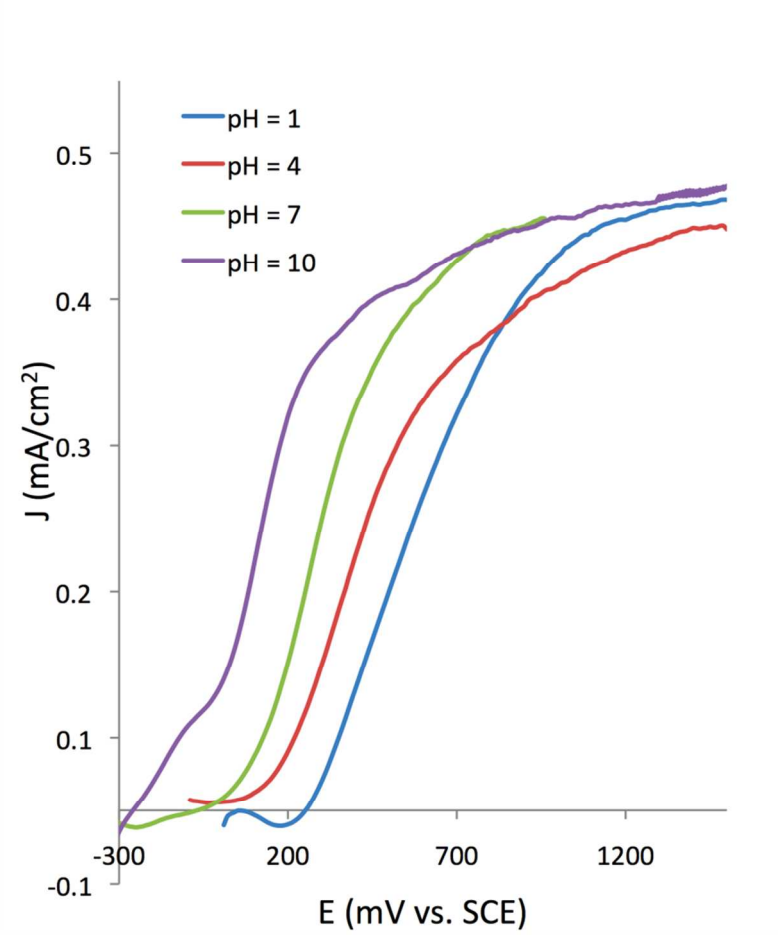

Figure S4: Plot of the photocurrent density vs. potential for WO_3 electrodes in electrolytes (0.10 M) having various pH values, including HCl (pH = 1.0) and acetate (pH = 4.0), phosphate (pH = 7.0), and carbonate (pH = 10) buffers. The porous WO_3 electrodes were prepared by anodization at 60 V for 9 h in 0.10 M NaF(aq) and annealed in air at 500 °C for 2 h. The electrodes were illuminated with 100 mW cm^{-2} of simulated sunlight.

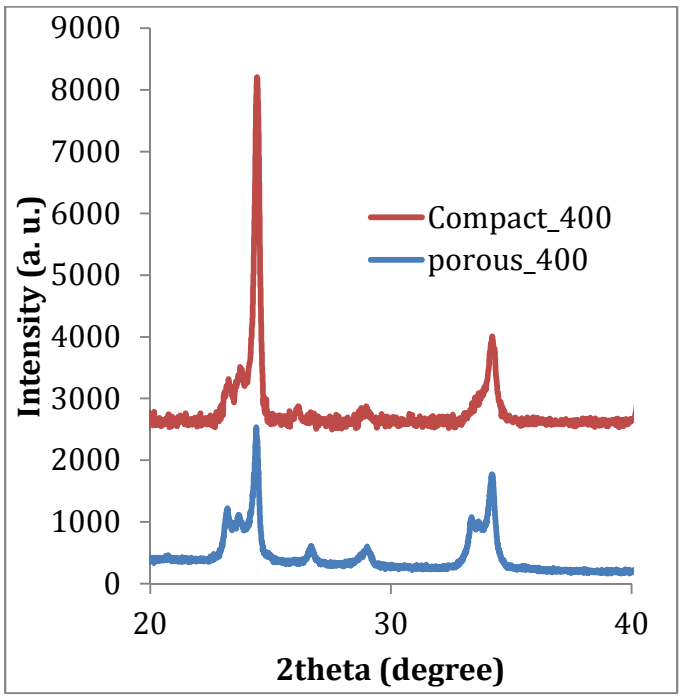

Figure S5: Powder X-ray diffraction pattern for a porous WO_3 electrode and a compact WO_3 electrode annealed in air at 400 °C.